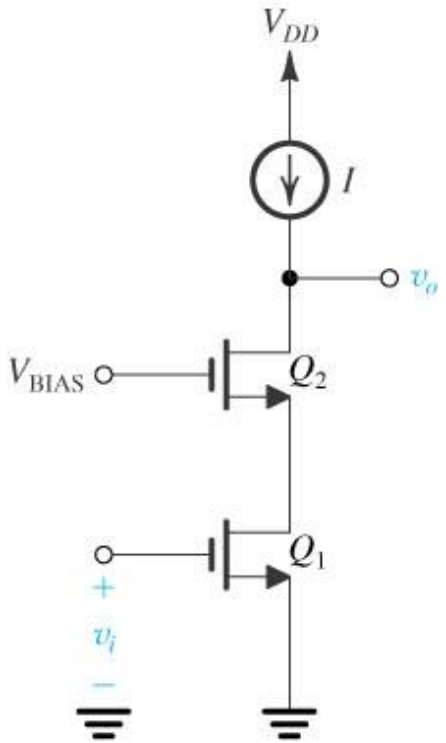
Cascode e Pares Amplificadores

- ✓ MOS Cascode
- ✓ BJT Cascode
- ✓ BiCMOS Cascode
- ✓ Par Darlington
- ✓ Outros Pares amplificadores

Cascode e Pares Amplificadores

Amplificador Cascode MOS

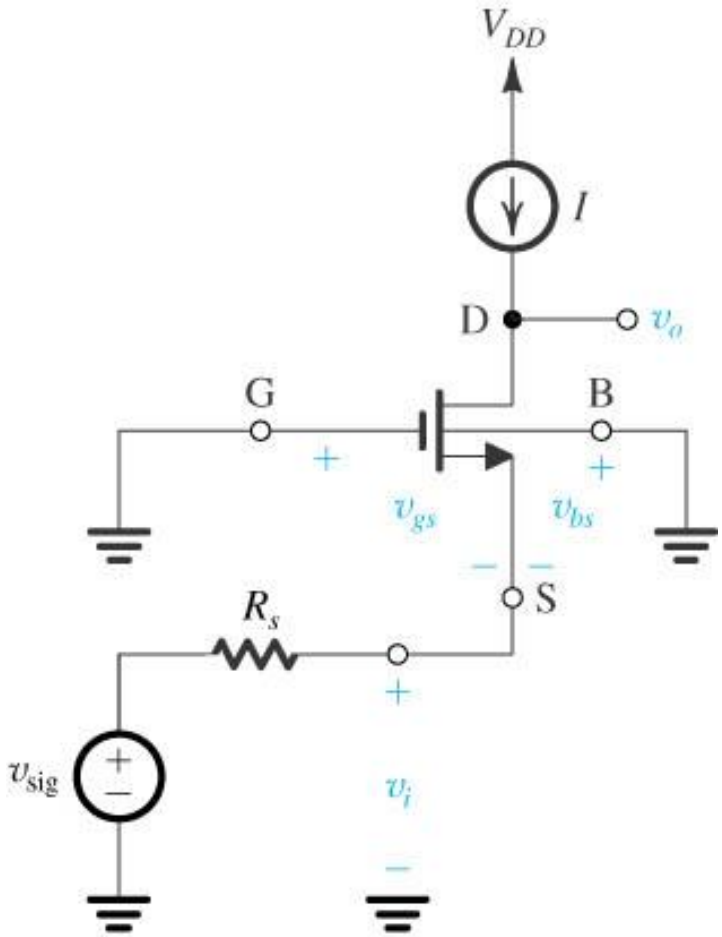


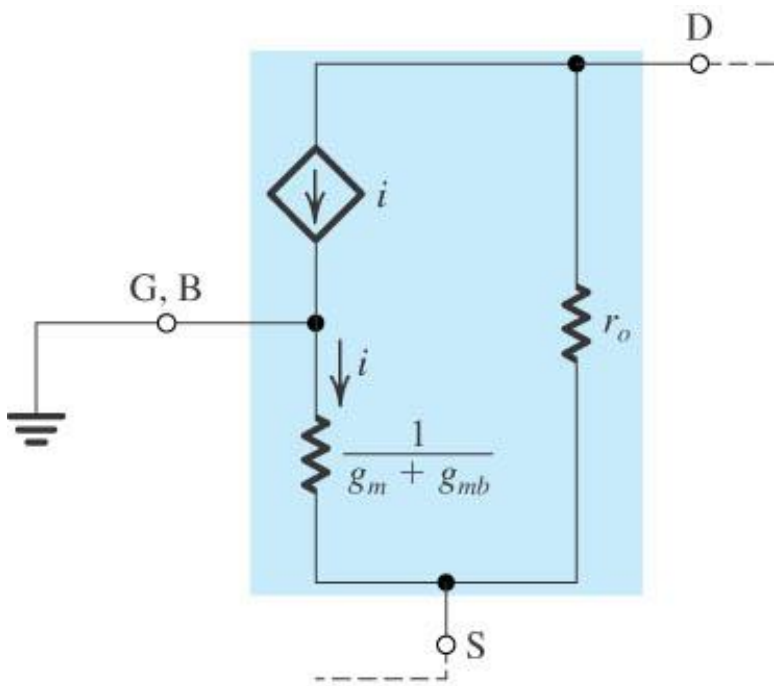
FC
Alta impedância de entrada e transcondutância
+
PC
Buffer de corrente e ótima resposta em freqüência

Amp. Fonte Comum + Porta Comum

Cascode e Pares Amplificadores

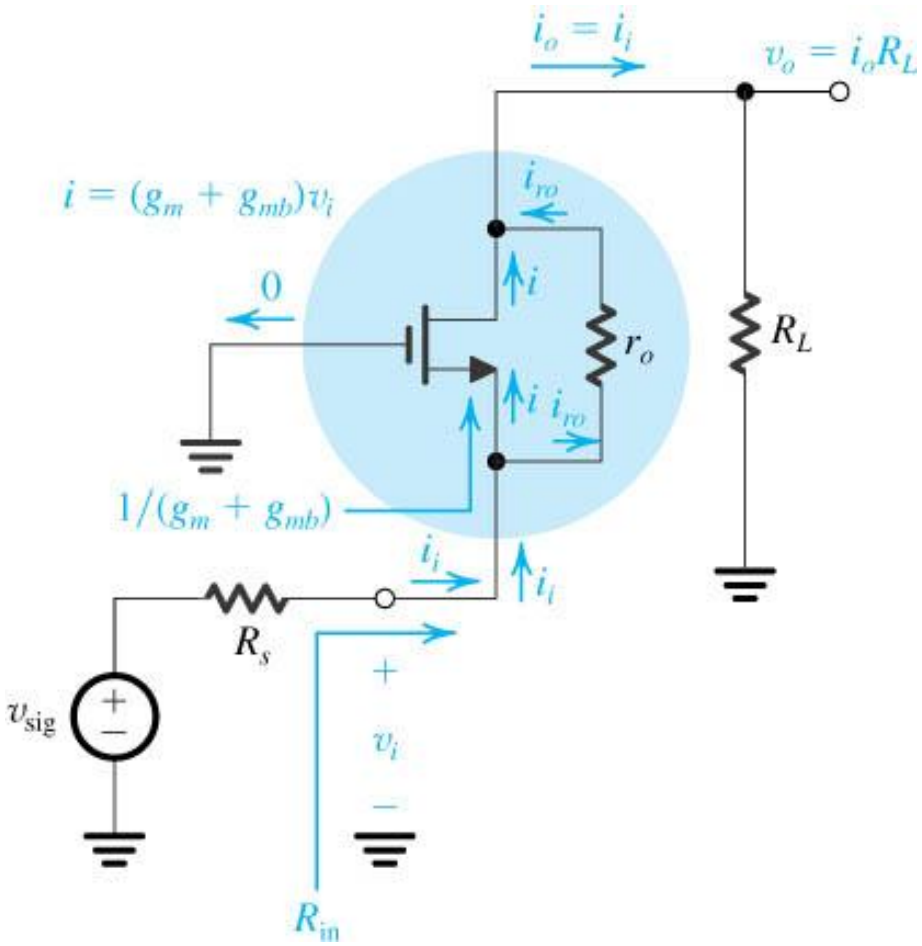
Análise do Amp. PC

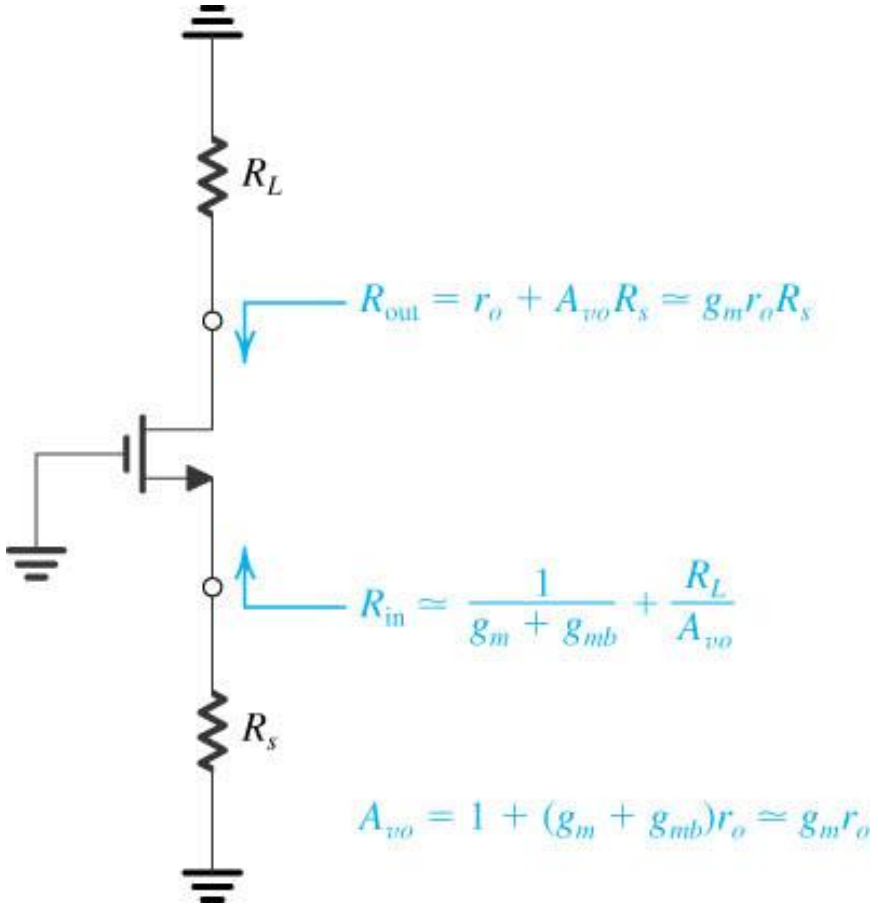




Cascode e Pares Amplificadores

Análise do Amp. PC

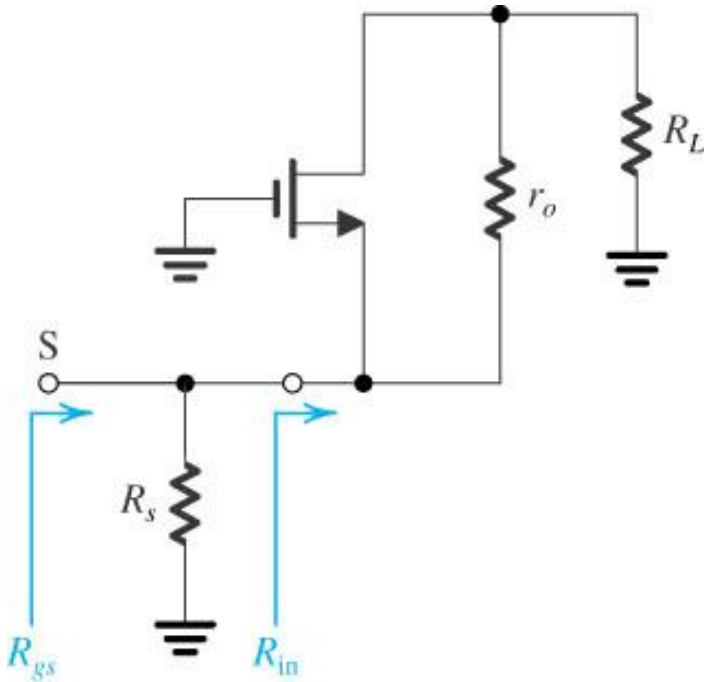




Transformador de impedâncias

Cascode e Pares Amplificadores

Ex.1 – Considere um amplificador porta comum com $r_o = 20\ k\Omega$, $I_D = 100\mu A$, $g_m = 1{,}25\ mA/V$, $\chi = 0{,}2$, $R_S = 20\ k\Omega$ e $R_L = 100\ k\Omega$. Encontre: A_{vo}, R_{in}, R_{out}, G_v, G_i.



$$A_{vo} = 1 + (g_m + g_{mb}) r_o$$

$$R_{in} = \frac{r_o + R_L}{A_{vo}} \qquad R_{out} = r_o + A_{vo} R_S$$

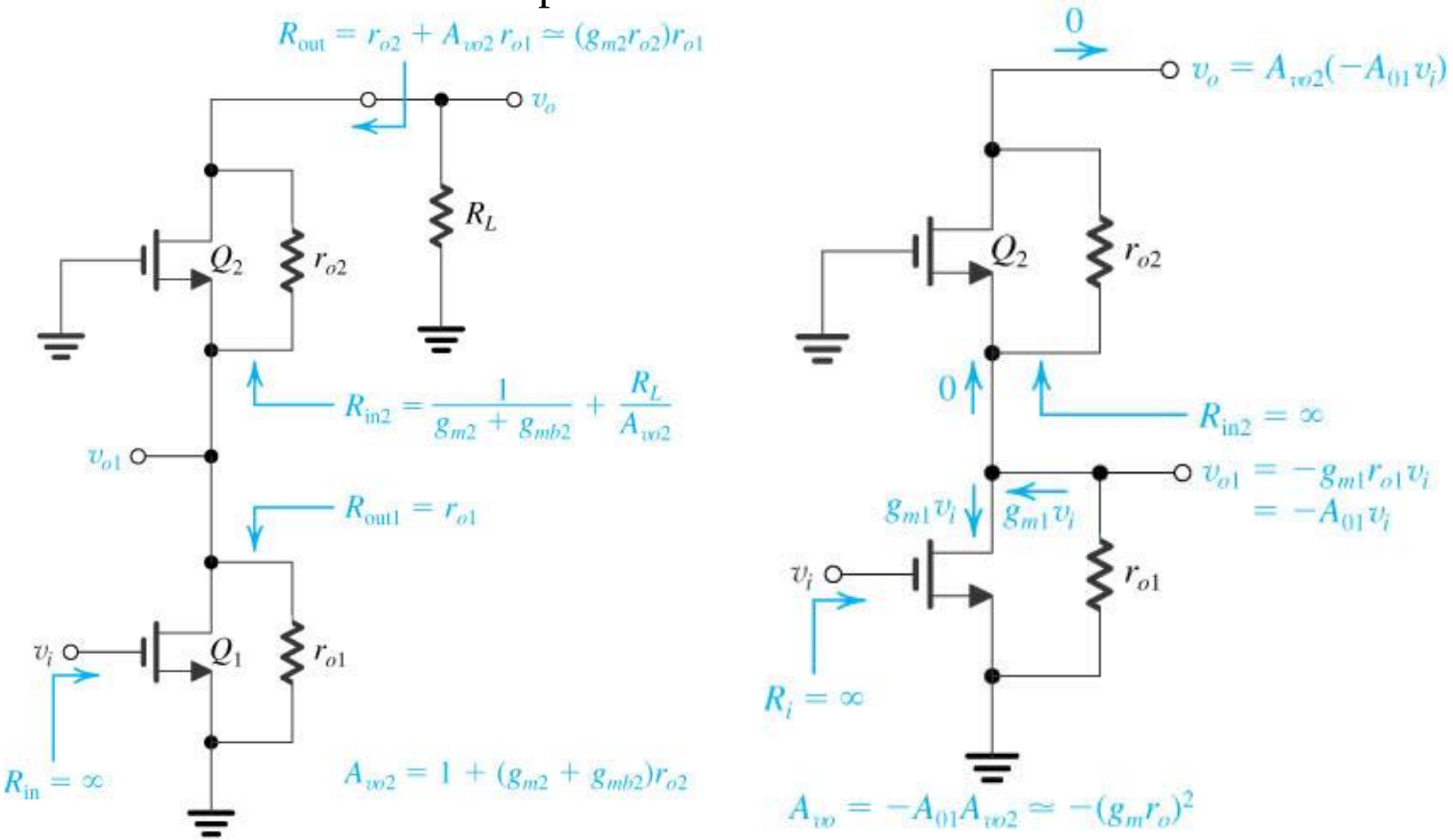
$$G_v = A_{vo} \frac{R_L}{R_L + R_{out}}$$

$$G_{is} = A_{vo} \frac{R_S}{R_{out}}$$

$$G_i = G_{is} \frac{R_{out}}{R_{out} + R_L}$$

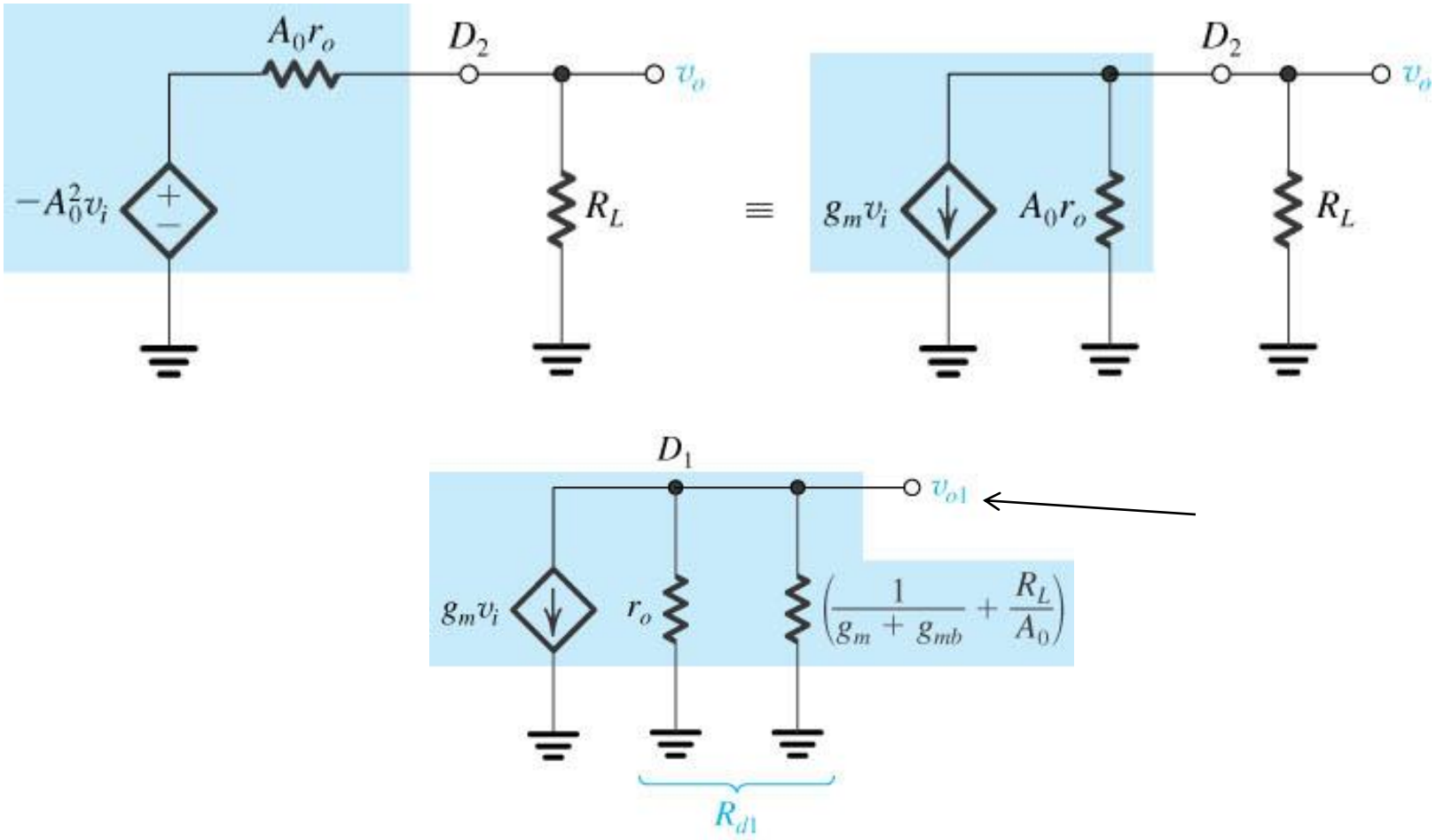
Cascode e Pares Amplificadores

Amplificador Cascode MOS



Cascode e Pares Amplificadores

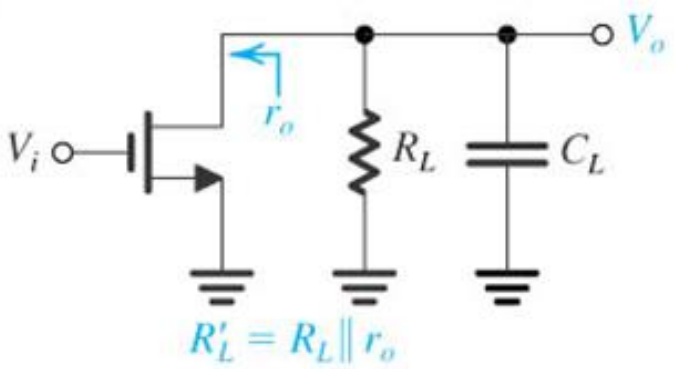
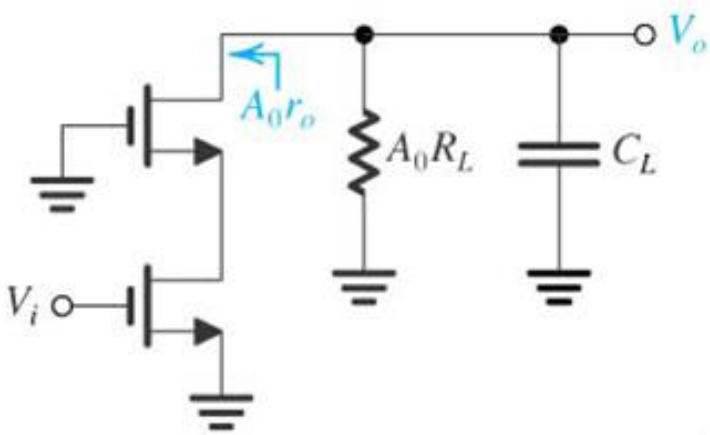
Amplificador Cascode MOS



Modelos de pequenos sinais para determinar o ganho A_v

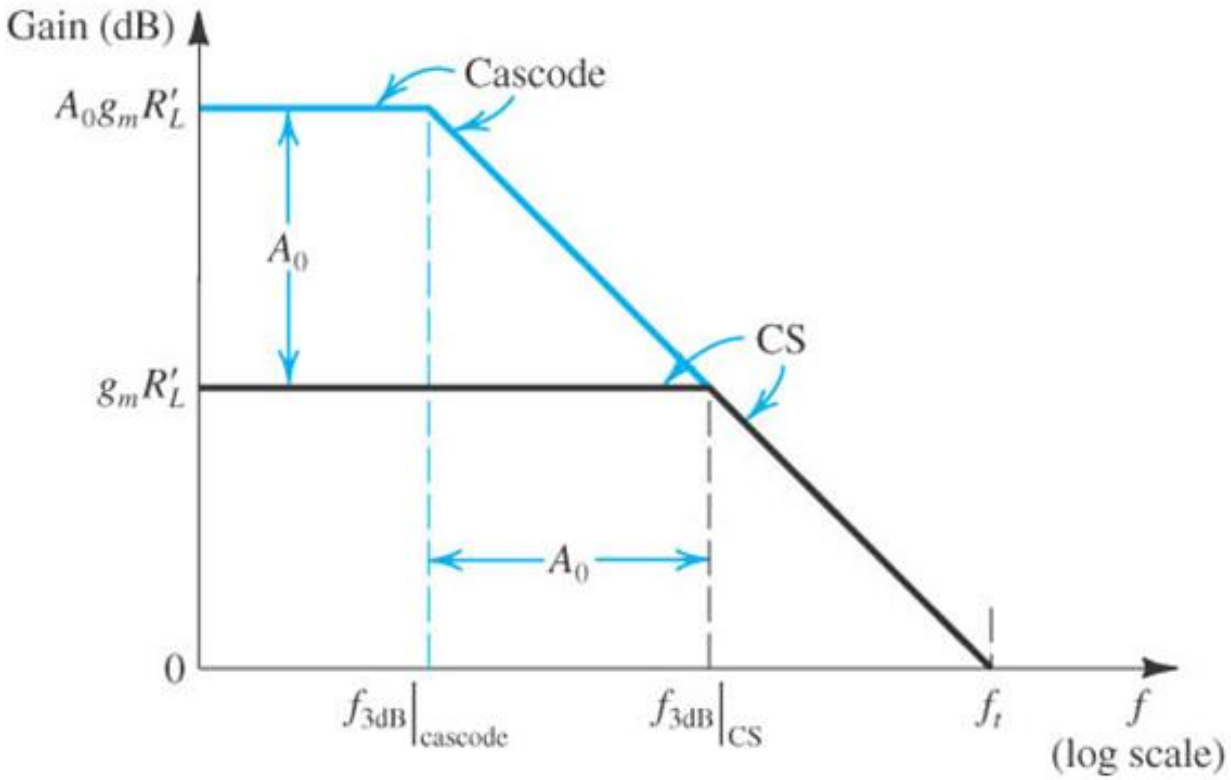
Cascode e Pares Amplificadores

Amplificador Cascode x Fonte Comum

	Common Source	Cascode
Circuit		
DC Gain	$-g_m R'_L$	$-A_0 g_m R'_L$
f_{3dB}	$\frac{1}{2\pi(C_L + C_{gd})R'_L}$	$\frac{1}{2\pi(C_L + C_{gd})A_0 R'_L}$
f_t	$\frac{g_m}{2\pi(C_L + C_{gd})}$	$\frac{g_m}{2\pi(C_L + C_{gd})}$

Cascode e Pares Amplificadores

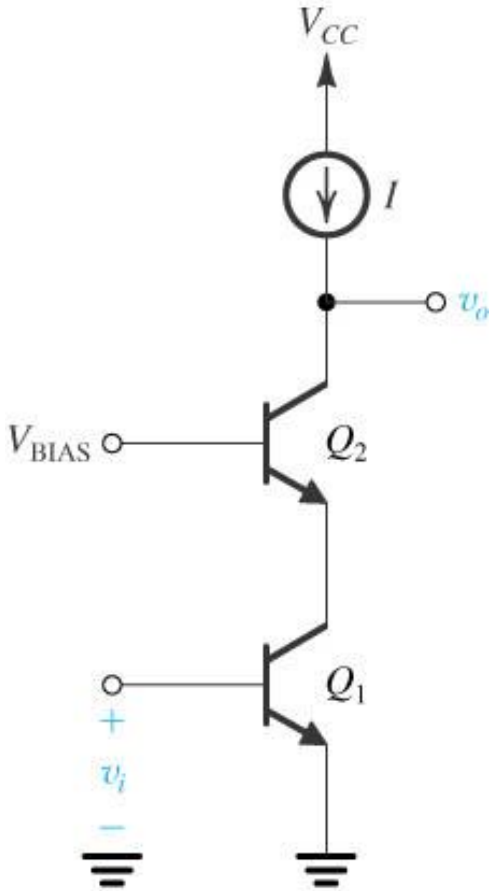
Amplificador Cascode x Fonte Comum

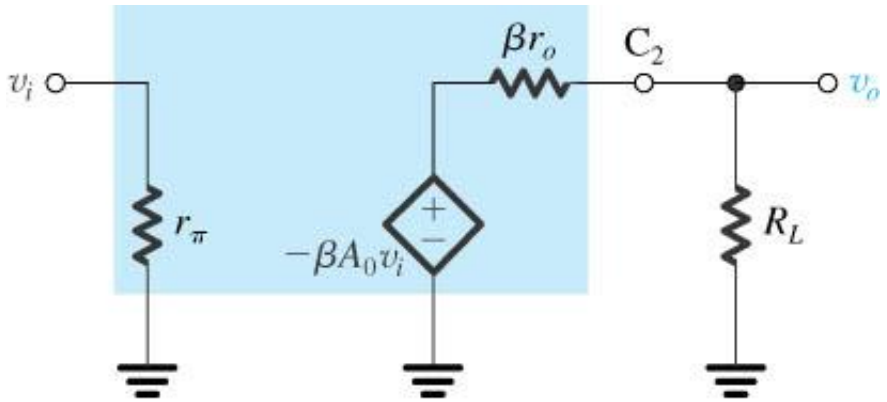


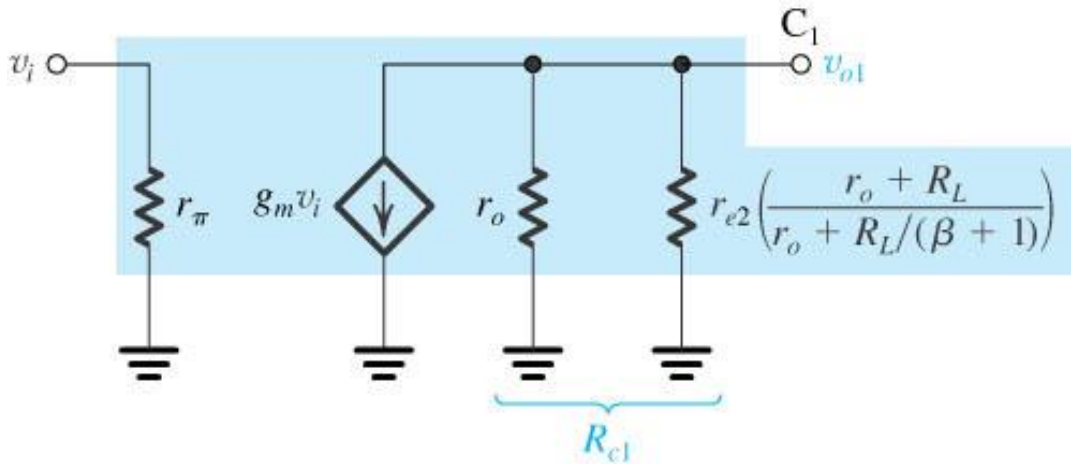
Produto Ganho x Banda = cte!

Cascode e Pares Amplificadores

Amplificador Cascode TBJ

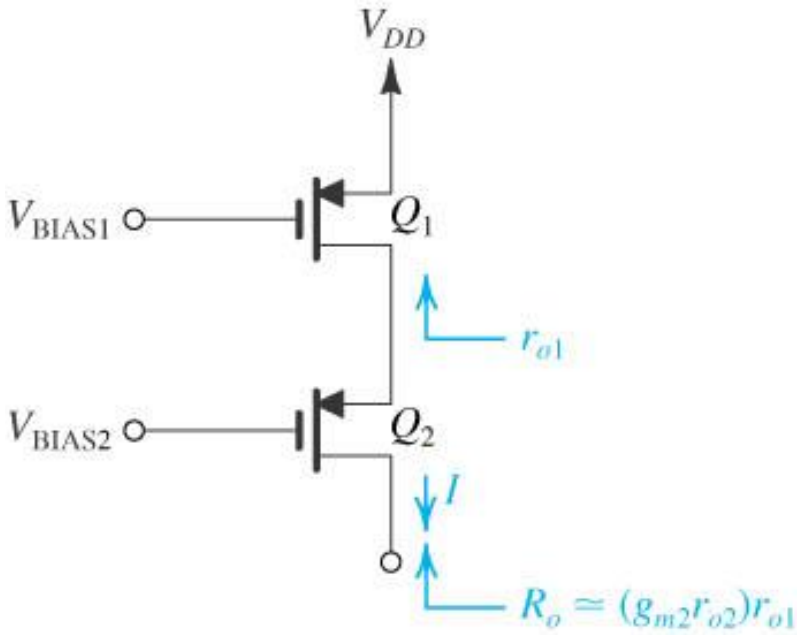


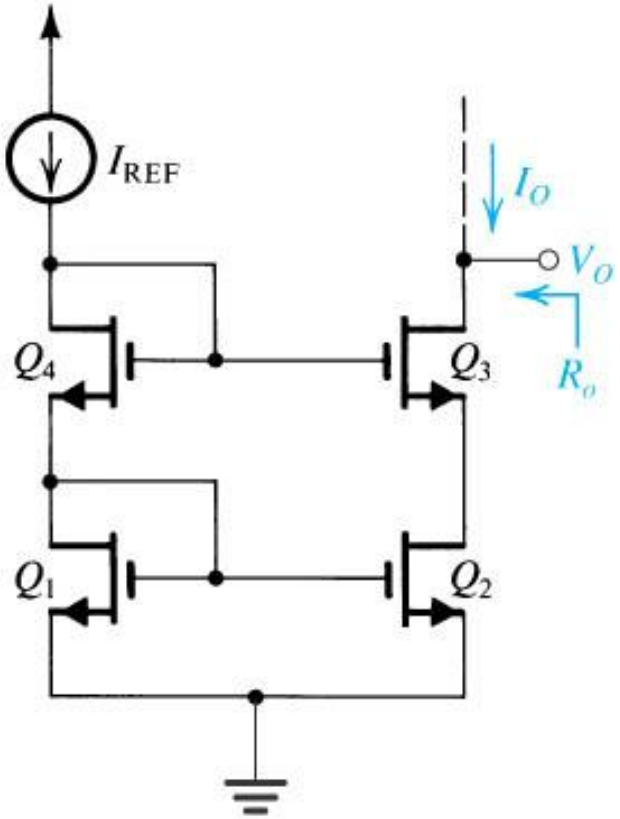




Cascode e Pares Amplificadores

Espelho de Corrente Cascode MOS

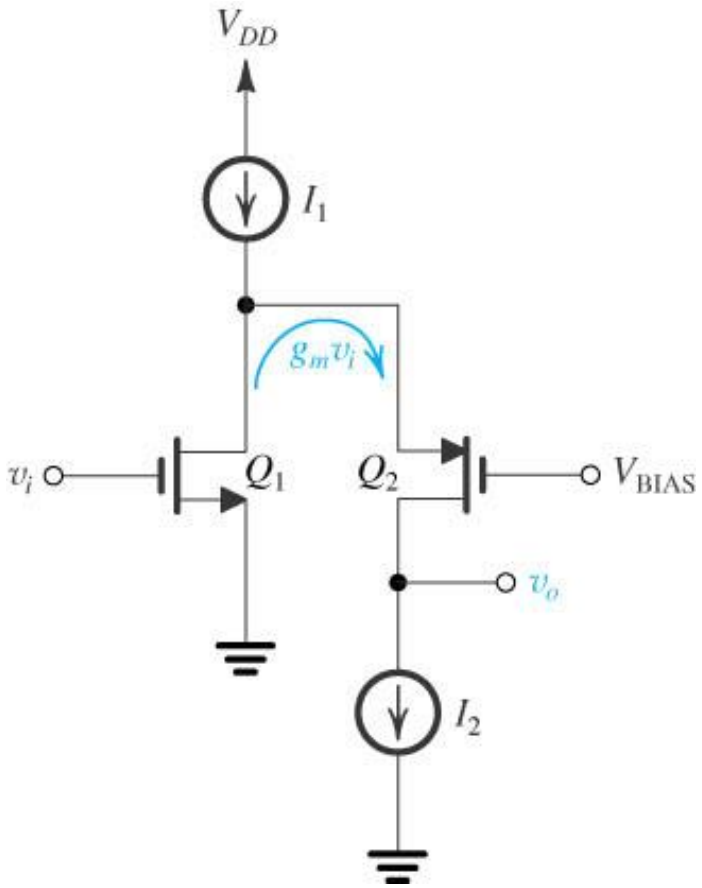




Possibilita o aumento da impedância de saída e diminuição dos efeitos de descasamento ao custo de uma diminuição da excursão da tensão de saída

Cascode e Pares Amplificadores

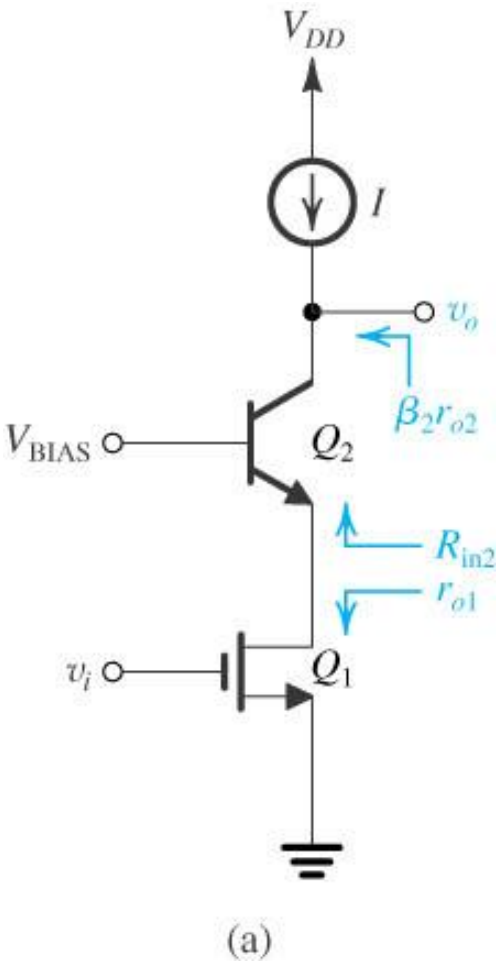
"Folded" Cascode - CMOS



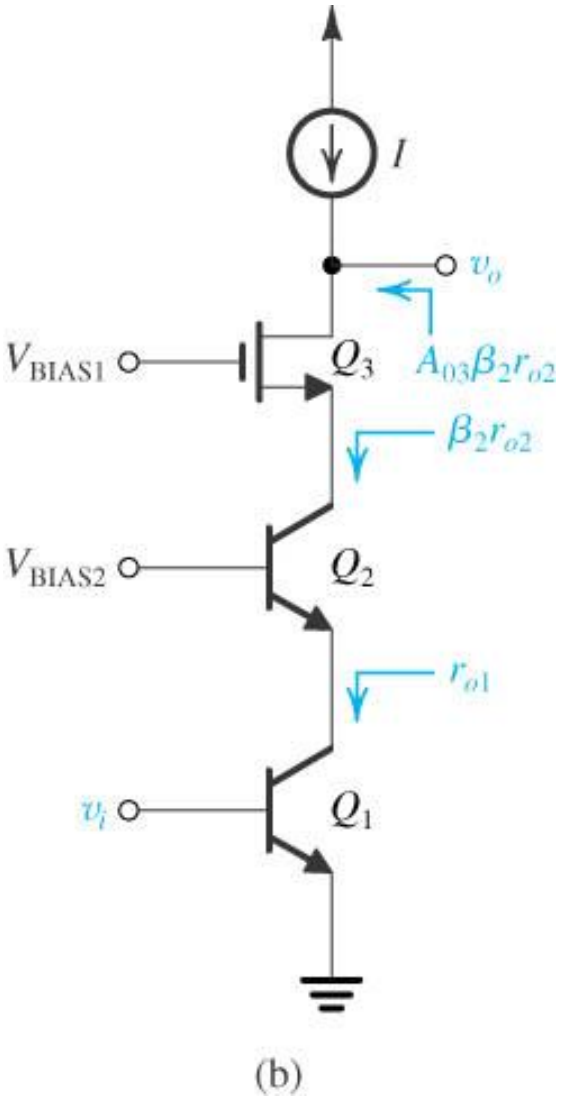
nMOS Fonte Comum, pMOS porta comum.

Cascode e Pares Amplificadores

BiCMOS Cascode



(a)



(b)

Cascode e Pares Amplificadores

Cascode

Alta impedância de entrada

Alta impedância de saída

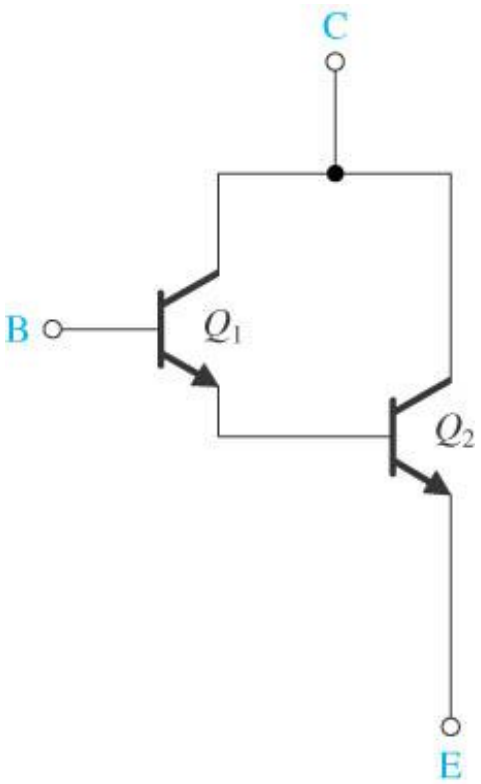
Alto Ganho **ou** Largura de Banda

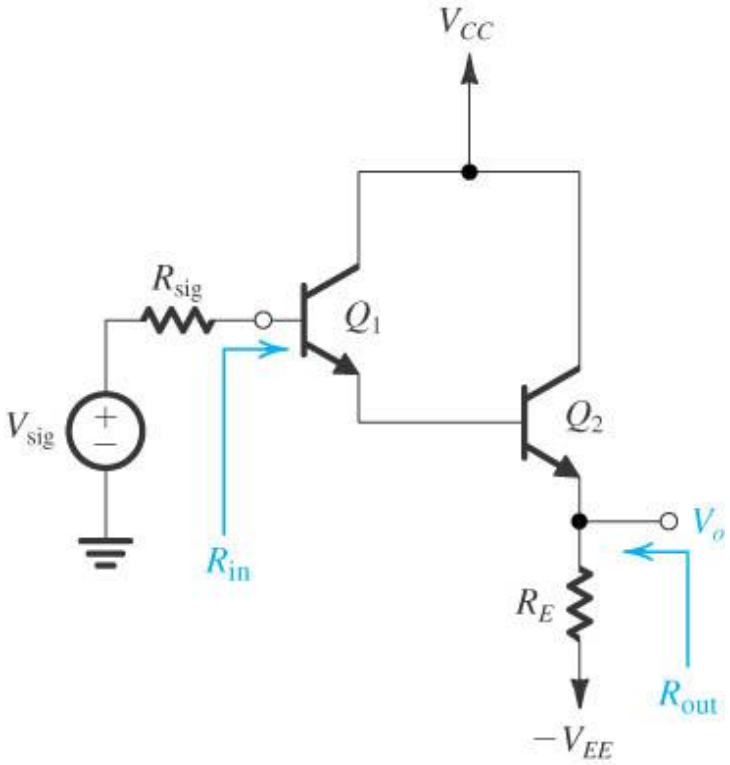
Ótima isolação entre saída e entrada

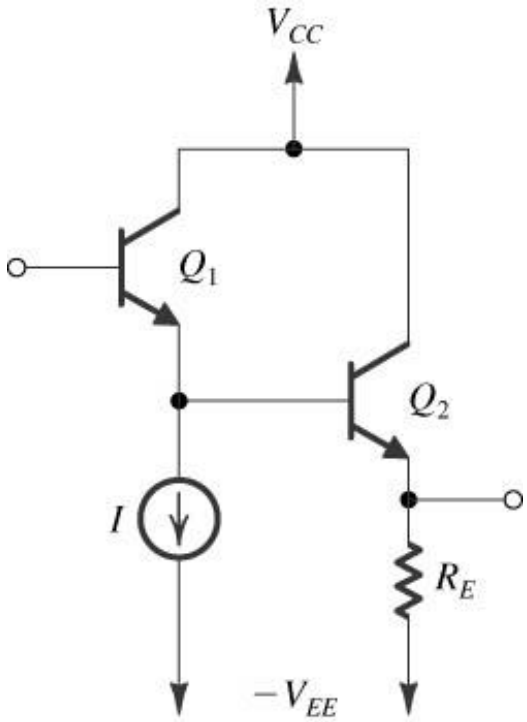
Diminuição do efeito Miller

Cascode e Pares Amplificadores

Par Darlington

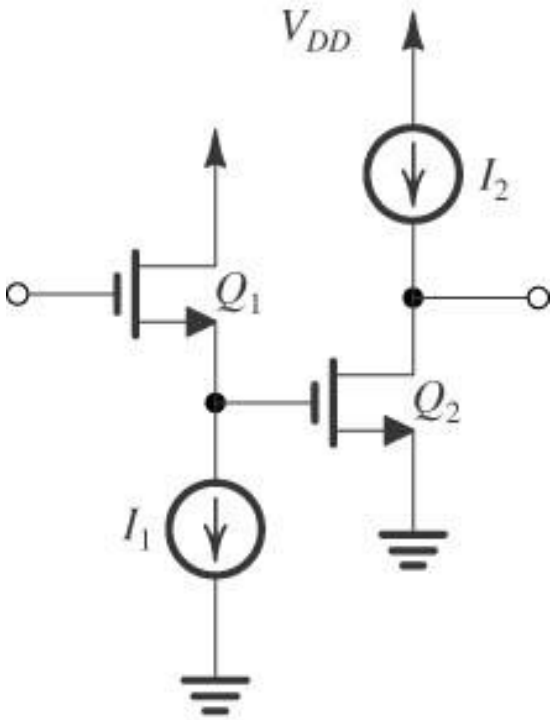




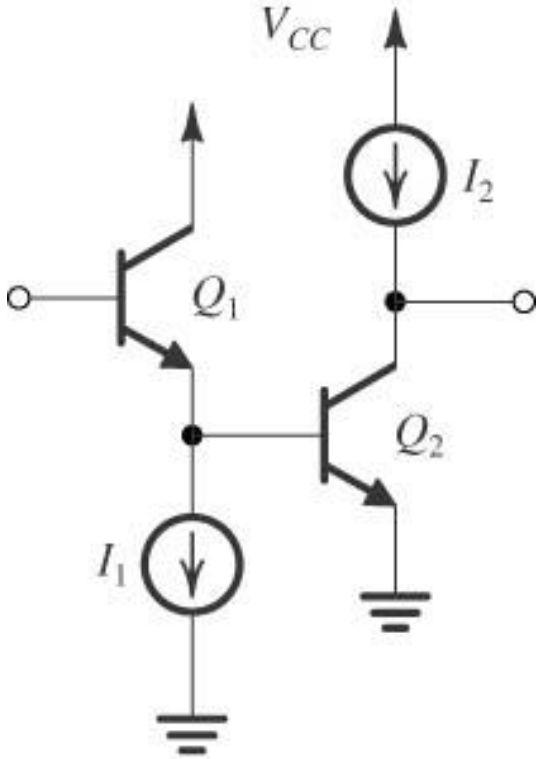


Cascode e Pares Amplificadores

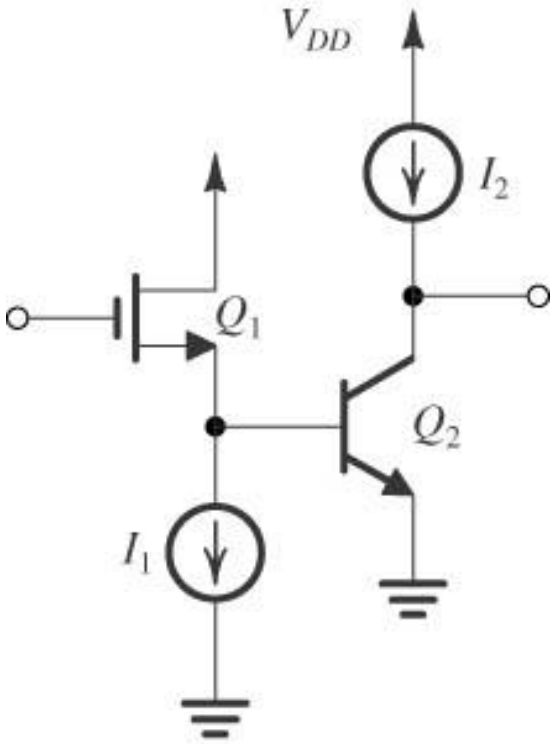
Outras configurações



DC+FC



CC+EC

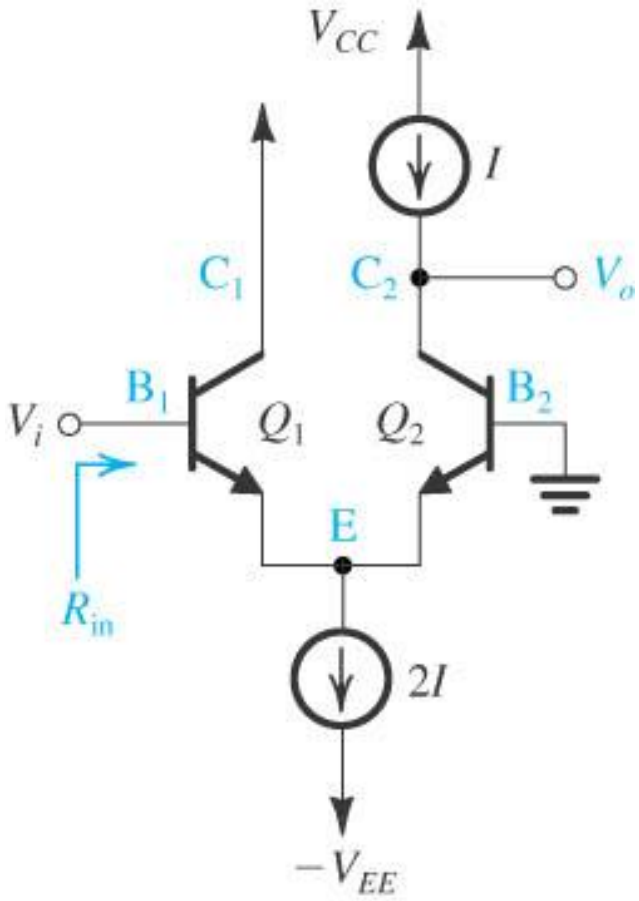


DC+EC

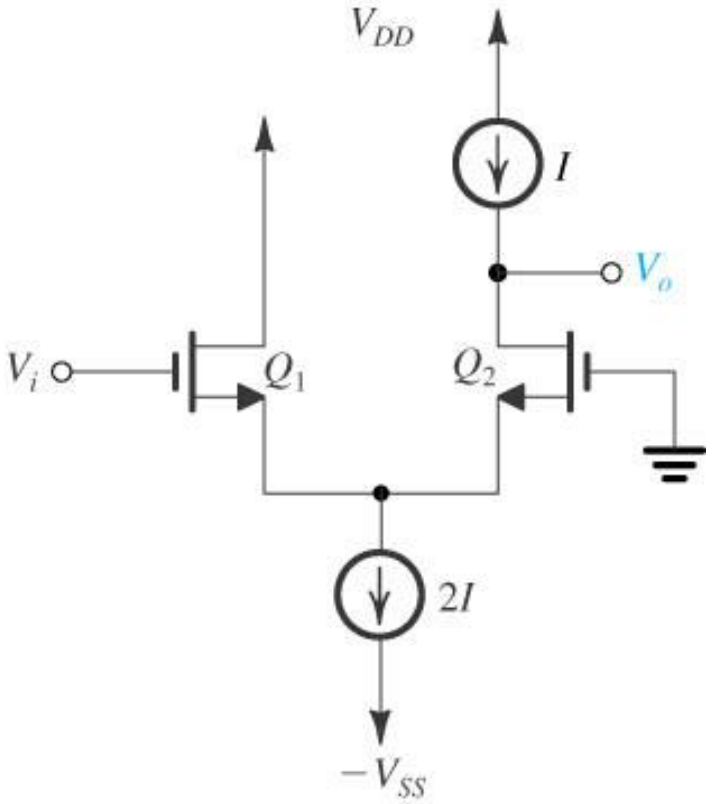
BiCMOS

Cascode e Pares Amplificadores

Outras configurações



CC+BC



DC+PC

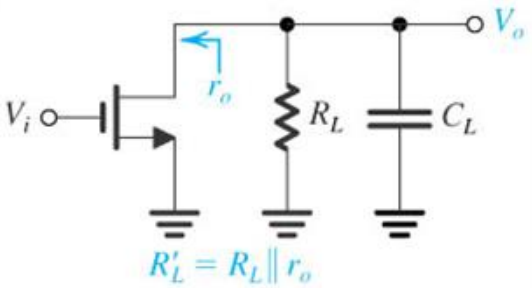
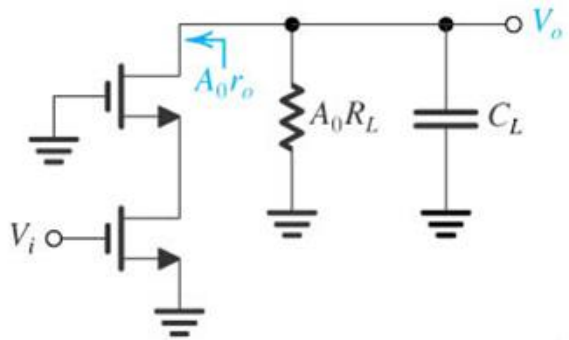
Cascode e Pares Amplificadores

Ex.2 – Compare o desempenho do amplificador Fonte comum com o amplificador Cascode. Assuma para todos os transistores:

W/L = 20, gm = 1,25 mA/V, χ = 0,2, r_0 = 20 kΩ, C_{GD} = 200 fF, e C_L = 500 fF.

a) $R_L = r_0$

b) $R_L = Rout$

	Common Source	Cascode
Circuit		
DC Gain	$-g_m R'_L$	$-A_0 g_m R'_L$
f_{3dB}	$\frac{1}{2\pi(C_L + C_{gd})R'_L}$	$\frac{1}{2\pi(C_L + C_{gd})A_0 R'_L}$
f_t	$\frac{g_m}{2\pi(C_L + C_{gd})}$	$\frac{g_m}{2\pi(C_L + C_{gd})}$

Cascode e Pares Amplificadores

Sugestão de Estudo:

- Sedra & Smith 5ed.
  - Cap. 6, item 6.7
  - Cap. 6, item 6.8
  - Cap. 6, item 6.11

- Razavi. 2ed. (somente estágio *cascode*)
  - Cap. 9, item 9.1

Exercícios correspondentes.